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Morphometric video analysis of the engine-driven nickel-titanium Lightspeed instrument system

Marsicovetere ES, Clement DJ, del Rio CE. Morphometric video analysis of the engine-driven nickel-titanium Lightspeed instrument system. J Endodon 1996;22:231-5.

PURPOSE: To analyze and evaluate the physical design and dimensions of the Lightspeed instrument system.

M&M: 12 Lightspeed instruments from 18 sizes between #20 and #80 were positioned in an instrument holder for microscopic examination at $\times 40$ magnification. Each instrument was visually evaluated for the presence of surface debris, corrosion, defects in machining of the alloy, and consistency in design. Randomly selected instruments were measured for the following: length of the noncutting pilot (distance from the tip of the instrument to the first cutting flute); length of the cutting surface of the instrument (distance from the first cutting flute to the last cutting flute); total length of the head, diameter of the head; diameter of the shaft (measured 1-2 mm behind the head); length of the land area (the noncutting surface behind the major diameter of the head); angle of the pilot tip; and angle of divergence of the cutting head.

RESULTS: Variable amounts of dust and epithelial cells were found on most instruments. 23 instruments had surface porosities, and 17 showed sharp strips of alloy protruding from the flute edges. No corrosion was detected on any instrument. In general, instruments of the same size were consistent in design, but variations concerned the pilot tip and cutting flutes. Conversely, instruments of different sizes showed variations in shape. Length progression of the pilot tip showed four shifts, and there were four different lengths of the head. Cutting surfaces were proportional to the length of the head. The diameter of the head increased progressively as the size increased, except for #40, whose mean diameter was less than the #37.5. There were no significant differences between several consecutive size pairs. Head diameters were consistently undersized; only 7/18 sizes met the ADA Specification No. 28 standard of ± 0.02 mm allowable tolerance. No relationship was found between land area, length of the head, length of the cutting surface, and length of the noncutting pilot. Pilot tip angles were not significantly different between sizes, yet 5 trends were found among the angles of divergence.

C&C: Quality control of the manufacturing process of Lightspeed instruments appears adequate, but needs improvement. Despite the poor accuracy in controlling instrument head diameters, manufacture was consistent, as evidenced by small variation in these measurements. Although many instruments were labeled to be different sizes, for practical purposes, they were the same instrument. This could account for the impression that root canal preparation with some instrument sizes feels more passive than with the immediately previous instrument. The Lightspeed instrument system is a series of instruments that show gradual shifts in both size and shape, as the size increases. ANSI/ADA Specification No. 28 for files and reamers does *not* apply to the Lightspeed instruments, because the design of these instruments is entirely different.

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Christopher F. Bates

Influence of particle size of hydroxyapatite as a capping agent on cell proliferation of cultured fibroblasts

Higashi T, Okamoto H. Influence of particle size of hydroxyapatite as a capping agent on cell proliferation of cultured fibroblasts. J Endodon 1996;22:236-9.

PURPOSE: To evaluate cultured cell reactions to the pulp-capping agent HA, using 2 different types and sizes of particles.

M&M: Dense and porous HA ceramic particles, made by sintering at 1200°C and 700°C, of two different particle sizes, 300 and 40 µm, were co-cultured with dental pulp-derived fibroblasts for 7 days. Cell reaction was observed by phase contrast and scanning electron microscopy. Proliferation of the cells was measured by counting the number of trypsinized cells in 7-day-old cultures.

RESULTS: The dense 300-µm particles of HA were completely covered by cultured fibroblast cells by the 7th day, while the porous and dense 40-µm particles were captured or gathered by seemingly non-proliferating cells. The porous 300-µm particles were accompanied by small broken pieces of HA; cells appeared to proliferate only around the larger particles.

CONCLUSIONS: The study showed that the larger HA particles were completely covered by cultured fibroblasts, while the smaller particles seemed to be held onto by the cells. These results suggest that large particles are biocompatible, while small particles may be considered foreign bodies and be rejected.

May 1996

Michael Hall

Interleukin-1a stimulates interstitial collagenase gene expression in human dental pulp fibroblast

Tamura M, Nagaoka S, Kawagoe M. Interleukin-1a stimulates interstitial collagenase gene expression in human dental pulp fibroblast. J Endodon 1996;22:240-3.

PURPOSE: To examine the effects of inflammatory cytokines on interstitial collagenase mRNA expression in cultured human dental pulp fibroblasts.

M&M: Pulp fibroblasts from an extracted 3rd molar were subcultured until confluent, and exposed to medium containing experimental additives at various times. Among the agents tested were interleukin-1a (IL-1a) and human transforming growth factor-b (TGF-b). Interstitial collagenase mRNA expression of these cells was examined by Northern blot analysis.

RESULTS: These fibroblasts did not express collagenase mRNA in an unstimulated condition. After exposure to IL-1a, collagenase mRNA expression was induced, and increased in a dose-related fashion. Levels began to increase after 2 hrs exposure, reached a maximum after 8 hrs, and then dropped to the unstimulated level at 48 hrs. TGF-b dramatically *reduced* the levels of collagenase mRNA expression that were induced by IL-1a.

C&C: Several interleukin-producing cells have been demonstrated in inflamed pulps. Inflammatory cytokines may, in turn, initiate and augment inflammatory processes in pulpal lesions. Interstitial collagenase mRNA expression in human dental pulp fibroblasts is apparently regulated by the inflammatory cytokines, as shown by this investigation. This enzyme is important in the degradation of extracellular matrix proteins, such as collagen and proteoglycans. Since this study was not performed in the human dental pulp per se, it only *suggests* that this mechanism plays important roles in pulpal lesions.

May 1996

Christopher F. Bates

In vitro cytotoxicity and dentin permeability of HEMA

Bouillaguet S, Wataha JC, Hanks CT, Ciucchi B, Holz J. In vitro cytotoxicity and dentin permeability of HEMA. J Endodon 1996;22:244-7.

PURPOSE: To determine a dose-response curve for HEMA in direct contact with cells in vitro, and to measure the concentration of HEMA that diffused through dentin in vitro as a function of dentin thickness, hydraulic conductance, and presence or absence of simulated pulpal pressure.

M&M: Ten concentrations of HEMA were tested, ranging from 0.01 to 100 mmol/L. A modified in vitro diffusion chamber measured the diffusion of HEMA through dentin disks obtained from non-carious human 3rd molars. Diffusion of HEMA through the dentin was determined by measuring the optical density of the diffusate by UV spectroscopy. The effects of three variables were assessed: changes in convection pressure to simulate presence of a physiologic pulpal pressure and its effect on the inward diffusion of HEMA; changes in the driving concentration of HEMA; and different dentin disk thicknesses. Cytotoxicity of HEMA to mouse fibroblasts was determined.

RESULTS: HEMA diffused rapidly through the dentin disks under all conditions; however, increased dentin disk thickness, increased back pressure, and decreased initial HEMA concentration all were effective in reducing diffusion.

C&C: As an ingredient in direct dentin bonding agents (DBA), HEMA might diffuse through dentin and be cytotoxic to the pulp. Part of this study determined that, while toxic to mouse fibroblasts, HEMA was less toxic than other components of DBA. It was seen that HEMA can diffuse rapidly through dentin in vitro, which could cause concern for such diffusion in vivo, but overall the risk of acute cytotoxicity appears to be low. What effects HEMA may have on hypersensitivity, complement activation, or other effects on odontoblasts are not known.

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Michael Hall

A commercially available cell culture device modified for dentin barrier tests

Schmalz G, Garhammer P, Schweiki H. A commercially available cell culture device modified for dentin barrier tests. J Endodon 1996;22:249-52.

PURPOSE: To test the cytotoxicity of several dental materials using a test device, and to compare the results with those found recently using an artificial pulp chamber constructed in the authors' laboratory.

M&M: The materials tested were zinc phosphate (ZP) cement (1:1 & 2:1 P:L ratios), ZOE (4.5:1), conventional glass ionomer cements (Ketac-Fil & Ketac-Silver), and light-cured GIC (Vitrebond). The commercially available cell culture device was modified by replacing the original membrane with a bovine dentin disk, as a substrate for cell growth. Mouse fibroblasts were grown on the etched side of the dentin disk facing the "pulpal" part of the device; whereas test materials were introduced into the upper chamber in direct contact with the "cavity" side of the dentin disk. The cells were exposed to the material in an incubator for 24 hrs. Viable cells on the disk were subsequently stained and counted.

RESULTS: ZP cement at a ratio of 2:1 had no cytotoxic effect, whereas ZP 1:1 was weakly cytotoxic (81% survival). Neither ZP was significantly different from the (-) control. Both conventional GIC's caused considerable cell damage, compared with ZP. Only 28% and 24% of the cells survived after exposure to Ketac-Silver and Ketac-Fil, respectively. These survival rates were significantly lower than that of the (-) control. With the Vitrebond and ZOE, no cells survived after 24 hrs exposure; these values were similar to the (+) control. A strong correlation was shown between survival rates of the mouse fibroblasts in this study, and data of a previous study, using the same materials in a different dentin barrier test device.

C&C: The clinical toxicity of GIC's has been shown to be low. Perhaps the reason for this study's findings is explained by the high sensitivity of the GIC toward fluids interfering with the setting process. In this investigation, it was not possible to thoroughly dry the dentin disk. Similarly, pulp studies on animals and humans do not support the high toxicity observed with ZOE cement in the present study. The authors can only surmise that the present dentin barrier test does not sufficiently simulate the clinical situation! [Each study rocket science on the side]

May 1996

Christopher F. Bates

Tensile and tear properties of dental dam

Svec TA, Powers JM, Ladd GD, Meyer TN. Tensile and tear properties of dental dam. J Endodon 1996;22:253-6.

PURPOSE: To determine the tensile and tear properties of 3 different weights of RD from two manufacturers.

M&M: Three specimen shapes were evaluated: ASTM D412 Die C dumbbell tensile specimen, rectangular tensile specimen with 1.74 mm hole, and ASTM D624 Die C tear specimen. Three weights, thin, medium, and heavy, were obtained from 2 companies: Hygenic and Aseptico. Samples were tested under two conditions, fresh and aged. Testing was done with an Instron machine at a crosshead speed of 50 cm/min. Percentage elongation was tested according to the method outlined in ASTM D412. Ten samples for each weight, manufacturer, and condition were tested. Means and standard deviations were calculated, and data for tensile strengths, tear strengths, and percentage elongations were analyzed.

RESULTS: For dumbbell tensile strength specimens, condition was the most important dependent variable. There were small but significant differences between manufacturers and weights of fresh and aged RD; in all but one case, aged materials were significantly weaker than fresh materials. For dumbbell percentage elongation, product and thickness were the most important dependent variables. For rectangular tensile strength specimens, condition was again the most important dependent variable. For tear strength specimens, product was most important, followed by thickness and condition.

CONCLUSIONS: Tensile strengths of fresh specimens for both manufacturers and all 3 weights were equal to or exceeded the value required in federal spec ZZ-R-690B Rubber Dam (Dental). Requirements for percentage elongation and resistance to aging were also easily exceeded. Aging produced significant differences for tensile strength and percentage elongation, but were well within the 50% value called for in the specs. Tear strength tests showed significant differences in comparisons of product, weight, and condition, but these results were inconsistent. The rectangular specimen with the small hole provided the most sensitive test for product and condition testing of the RD.

May 1996

Michael Hall

The antimicrobial effect within dentinal tubules of four root canal sealers

Heling I, Chandler NP. The antimicrobial effect within dentinal tubules of four root canal sealers. J Endodon 1996;22:257-9.

PURPOSE: To evaluate the efficacy in killing bacteria in infected dentinal tubules of four sealers, which contain different antimicrobially-active ingredients.

M&M: Bovine incisors were decoronized, and sectioned into 4-mm lengths. Following standardized canal lumen preparation, the smear layer was removed with 17% EDTA. The sections were autoclaved prior to being inoculated with *fresh Enterococcus faecalis* over a 5 d period. The tested sealers were mixed, placed into the dentin section lumen, and incubated for 24 hrs (48 hr for AH26 because of its delayed setting), or 7 d. The groups were: a eugenol-based sealer - Pulp Canal Sealer EWT (Kerr); a calcium hydroxide sealer - Sealapex (Kerr); an epoxy resin sealer - AH26 Silverfree (De Trey Dentsply); a glass ionomer sealer - Ketac-Endo (ESPE); and a control - saline. The sealers were removed, and sterile round burs were used in sequence to remove dentin powder from the lumina. Powder samples were cultured, and the purity of the medium was determined by optical density measurements.

RESULTS: Except for the 24 hr Ketac-Endo group, all sealers showed antimicrobial activity. At 7 d, Ketac-Endo developed a significantly higher antimicrobial effect. The most prominent antimicrobial activity was demonstrated by AH26 at both time intervals, with no significant difference between its effects at the two time intervals. The activity of Pulp Canal Sealer EWT was similar at 24 hr and 7 d. Sealapex had significantly greater antibacterial effect at 7 d than it did at 24 hr.

C&C: Eliminating bacteria from the root canal system is essential for long-term treatment success. The proposed active, bactericidal ingredients include, for AH26 - formaldehyde; Ketac-Endo - fluoride; Sealapex - calcium hydroxide; and Pulp Canal Sealer EWT - eugenol.

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Christopher F. Bates

An in vivo comparison of gradient and absolute impedance electronic apex locators

Lauper R, Lutz F, Barbakow F. An in vivo comparison of gradient and absolute impedance electronic apex locators. J Endodon 1996;22:260-3.

PURPOSE: To evaluate the accuracy in vivo of two EALs based on the absolute and gradient impedance principles.

M&M: 22 teeth scheduled for extraction in 11 patients were used in this study. Working lengths were determined for each canal, beginning with the Odontometer, an absolute impedance EAL, in a dry canal, followed by the Apit EM-S1, a gradient impedance EAL, in a wet canal. WL was recorded when “Apical Constriction” appeared on the LCD screen on the Odontometer, and when “Apex” appeared on the Apit screen. In most cases, only 2 consecutive readings were necessary to confirm electronic WL for both the Odontometer and the Apit. Following confirmed readings, the file used to record the WL was rigidly secured in the crown with rapid curing acrylic, which was then removed, and reinserted to check the fit. After extraction, dentin was removed with a Hedstrom file apically to produce a thin slit enabling localization of the file tip; the file embedded in acrylic was then able to be placed in the canal in each instance, and the relationship of the file tip to the apical foramen was able to be recorded.

RESULTS: The mean difference between the file tip and the apical foramen for the Odontometer was -0.36 ± 0.71 mm coronal to the apical foramen, while for the Apit, it was $+0.14 \pm 0.27$ mm beyond the apical foramen; differences between the means for each EAL were statistically significant. When presented as percentages, 73% and 93% of the findings for the Odontometer and the Apit, respectively, fell within the range of -0.5 mm to $+0.5$ mm.

DISCUSSION: This study measured the WL of each canal in vivo with 2 EALs, and then verified the accuracy by direct measurement following extraction. Although the Apit showed a greater degree of accuracy within 0.5 mm apical or coronal to the apical foramen, recordings for the Apit more frequently were beyond the foramen, 70%, than the Odontometer, 36.6%. Those clinicians who wish to avoid overinstrumentation and overfill may desire the Odontometer over the Apit, while the Apit has the advantage of yielding more accurate results in a wet canal, but with the risk of having a WL slightly beyond the apical foramen. Radiographs should be used in conjunction with any EAL.

May 1996

Michael Hall

Incomplete healing (scar tissue) after periapical surgery - radiographic findings 8 to 12 years after treatment

Molven O, Halse A, Grung B. Incomplete healing (scar tissue) after periapical surgery - radiographic findings 8 to 12 years after treatment. J Endodon 1996;22:264-8.

PURPOSE: To determine if the slow healing pattern of post-surgical periapical scars means they will eventually become failures; and, if bony regeneration continues such that these lesions disappear with time.

M&M: 477 teeth were treated by periapical surgery, and followed for at least 1 yr. Cases were categorized as complete healing, incomplete healing (scar tissue), uncertain healing, or unsatisfactory healing at follow-ups. 2-6 yrs after surgery (mean observation period-4 yrs), 35 cases remained in the scar tissue group. 24/35 (all maxillary teeth - 19 lateral incisors, 3 central incisors, and 2 cuspids) could be further followed 8-12 yrs postoperatively (mean observation period-9½ yrs).

RESULTS: No clinical findings of failure were found in any of the 24 cases. Radiographically, 22 cases (92%) remained in the scar tissue group; 1 was recorded as completely healed, and another as unsatisfactorily healed. The scar tissue cases exhibited a decrease of the defect during the extended observation period. Residual defects of varying sizes were observed along with partial or full re-establishment of the PDL around the resected root surface. Three radiographic categories of the incompletely healed cases could be demonstrated: (1) a widened periodontal space around the root end and a small defect in the bone just above the resected surface (n = 2); (2) a rarefaction with irregular outline and in contact with the root end (n = 7); and (3) a defect surrounded by compact bone at a distance from the root end (n = 13).

C&C: The authors claim that root-end resections showing features of being periapical scars 1 yr post-operatively do *not* require periodic clinical and radiographic re-evaluation, and that follow-ups can be terminated after 1-yr. "These cases should either heal completely or remain in the scar group". They also later state that scar cases in the first two radiographic categories (described above) could represent a minor irritation still present in the area, and may be reevaluated after 4-5 yrs. A practical and economical follow-up plan is offered: All cases are evaluated 1 yr post-operatively. Cases believed to be periapical scar tissue healing are regarded as successes. Uncertain healings are re-evaluated 3 yrs later. Unsatisfactory healings at the 1-yr recall are considered failures.

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Christopher F. Bates

Endodontic retreatment of unusually long maxillary central incisors

Cohenca N, Karni S, Heling I, Rotstein I. Endodontic retreatment of unusually long maxillary central incisors. J Endodon 1996;22:269-71.

PURPOSE: To describe the endodontic management of a patient with exceptionally long max central incisors.

CASE REPORT: A 17-yr-old male was referred for RCT of #8 and #9 which had been traumatically displaced 6 yrs earlier and endodontically treated soon after. The coronal fillings were defective and radiographic exam revealed poorly compacted root canal fillings. Retreatment was initiated. Working length was determined to be 32 mm for #8 and 31 mm for #9. The plastic handles of 31 mm K files were trimmed to achieve correct WL. The root canals were filled with laterally condensed GP and sealer following cleaning and shaping.

DISCUSSION: Bjorndal et al. in 1974 examined extracted teeth from young males and determined the average length of max centrals to be 23.7 mm, with a maximum length of 27.3 mm. Booth, 1988, described a case of a 31-yr-old female with a max canine of 41 mm and a max central of 30 mm. The RCT of such long teeth may present debridement, irrigation, and obturation difficulties. The authors in this case trimmed the plastic handle to enable correct WL to be achieved. We of course have access to doggy endo files and are well-trained in rolling custom GP cones for obturation when encountering unexpectedly long roots.

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Michael Hall